NATIONAL UNIVERSITY OF ENGINEERING

COLLEGE OF ENVIRONMENTAL ENGINEERING

HYGIENE AND INDUSTRIAL SAFETY ENGINEERING PROGRAM

SA633 – INDUSTRIAL HYGIENE

I. GENERAL INFORMATION

CODE	**:**	SA633 Industrial Hygiene
SEMESTER	**:**	5
CREDITS	**:**	3
HOURS PER WEEK	**:**	4 (Theory – Practice)
PREREQUISITES	**:**	PI111 Mass and Energy Balance
CONDITION	**:**	Compulsory

II. COURSE DESCRIPTION

This course prepares students for the understanding of the different dangers and hazards that could arise in chemical processes, and apply appropriate, safe and effective preventive and corrective measures. Students understand the framework for managing the integrity of operating systems and processes handling hazardous substances by applying good design principles, engineering, and operating practices. The course deals with the prevention and control of incidents that have the potential to release hazardous materials or energy that can cause toxic effects, fire, or explosion resulting in serious injuries, property damage, lost production, and environmental impact.

III. COURSE OUTCOMES

At the end of the course, students:

1. Understand the importance of taking into consideration safety measures in the operation, planning and management of chemical processes.
2. Prevent and control incidents that have the potential to release hazardous materials or energy in chemical process or operation.
3. Identify the protection layers to be implemented in chemical plants for the safe processing of hazardous materials.
4. Formulate models for analyzing and determining points of potential spills and leaks.
5. Determine the risk of fire and explosion in chemical processes and operations.
6. Knows and apply norms and recommendations on safety of chemical processes and operations at industrial and laboratory levels, as well as Peruvian regulations on the matter.

IV. LEARNING UNITS

1. INDUSTRIAL SAFETY

Concepts and definitions / Identification of risks and their mitigation / Identification of energy sources / Risks of static electricity / Regulations on industrial safety and hygiene / Toxic products / Relative toxicity / Limit value of toxic doses.

2. CHEMICAL PROCESS SAFETY

Protection layers in a chemical plant / Identification of potential risks and hazards / Typical diagrams for the identification of risk points / Preventive protection layers / Mitigation layers / Safety management.

3. METHODS FOR RISKS IDENTIFICATION
Qualitative methods for risk identification / Methods selection and application on the different stage of a chemical plant development / Methods: What-If, Hazop, Checking List / Dangers and risks / Evaluation of risk in processes / Semi-quantitative methods for risk determination.

4. DEPRESSURIZING AND RELIEF SYSTEMS
Relief devices types / Relief scenarios / Components of a relief system.

5. MODELS FOR DETERMINING SPILLS AND LEAKS
Liquid flows in piping, orifices and tanks / Gas flows in piping and orifices / Liquid spill and flash conditions / Liquid and gas leaks.

6. FIRE AND EXPLOSIONS
Difference between fire and explosion / Inflammability characteristics of liquids and vapors / Self-ignition / Self-oxidation / Explosions / Detonation and deflagration / Explosion owed to over-pressure / Generated energy in chemical and mechanical explosions / Explosions generated by liquid boiling.

7. DESIGN FOR PREVENTING FIRE AND EXPLOSIONS
Process inertization / Inertization methods / Vacuum drain / Applications / Explosion-proof equipment / Fire and explosion preventing design.

8. INCIDENT INVESTIGACTION AND CHANGE MANAGEMENT
Basic methodology for determining the root cause of an incident / Change management in an chemical process plant.

V. PRACTICAL WORK

1. Safety analysis of Unit Process Laboratory
2. Reading and interpretation of safety engineering drawings
3. Risk analysis of a study-case.
4. Dimensioning of safety valves
5. Determination of spills and leaks.
6. Study case: fire, explosions and spills in real plants around the world.

VI. METHODOLOGY

Expository-Interactive method: instructor lecture, student exposition. Guided discussion method: managing of the group to approach situations and come to conclusions and recommendations. Along the course, several cases of hazards in chemical plants are analyzed for determining causes, and formulating preventive safety measures. At the end of the course, students work in teams to analyze the safety of a chemical plant. Student active participation is promoted.

VII. EVALUATION FORMULA

The average grade PF is calculated as follows:

PF = (EP+EF+((P1+P2+P3+P4+P5+P6)/5)/3

EP: Mid-Term Exam EF: Final Exam
P#: Quizzes

VIII. BIBLIOGRAPHY

1. **CROWL Daniel, LOUVAR Joseph**
   Chemical Process Safety, Fundamentals with Applications.
   Prentice hall, 2011.
2. **HYATT Nigel**
   Guidelines for Process Safety Analysis. Hazard Identification and Risk Analysis.
   CRC Press, 2010